

REMARKS

Reconsideration and withdrawal of the objection and rejections set forth in the above-mentioned Official Action in view of the foregoing amendments and the following remarks are respectfully requested.

Claims 1, 3-10 and 12-18 are now pending in the application, with Claims 1 and 10 being independent. Claims 2 and 11 have been cancelled without prejudice. Claims 1, 3-10 and 12-18 have been amended herein.

The drawings were objected to for allegedly not showing the "buffer chamber" recited in the original claims. It is respectfully submitted that such buffer chamber is clearly shown in the drawings, but the terminology has been changed to --buffer portion-- in the claims to even more clearly demonstrate such support. For example, at page 12 of the specification, it is described that the four nozzles at each of the printhead shown in Figure 6 are blocked and constitute a buffer chamber. Further, a buffer portion R is filled with bubbles from the buffer chambers. In view of the foregoing, reconsideration and withdrawal of the objection of the drawings are requested.

Claims 1-18 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite. Without conceding the propriety of this rejection, Applicants have reworded the language questioned by the Examiner. Reconsideration and withdrawal of the § 112, second paragraph, rejection are requested.

Claims 1-18 were rejected under 35 U.S.C. § 102 as being anticipated by European Patent Document No. 0 496 533 (Yano et al.). This rejection is respectfully traversed.

As is recited in independent Claim 1, the present invention relates to a method of filling a buffer portion in a print head with at least one bubble. The method uses a printhead comprising a plurality of ejection openings through which ink is ejected, a plurality of channels that are each in communication with a corresponding one of the plurality ejection openings, a common liquid chamber for supplying ink to the plurality of channels, a buffer portion located at an end of an arrangement direction of the channels to restrain vibration of ink in the common liquid chamber which occurs as a result of ejection of the ink, and bubble generating means for filling the buffer portion with at least one bubble. The method comprises the steps of filling the buffer portion with at least one bubble by driving the bubble generating means and executing a recovery process of discharging the ink through the ejection openings after the bubble filling step. In the recovery process step, excess of the at least one bubble filled in the buffer portion is removed.

As is recited in independent Claim 10, the present invention relates to a printing apparatus that is able to print an image on a printing medium. The apparatus uses a print head comprising a plurality of ejection openings through which ink is ejected, a plurality of channels that are each in communication with a corresponding one of the plurality of ejection openings, a common liquid chamber for supplying ink to the plurality of channels, a buffer portion located at an end of an arrangement direction of the channels to restrain vibration of ink in the common liquid chamber which occurs as a result of the ejection of the ink, and bubble generating means for filling the bubble chamber with at least one bubble. The apparatus includes recovery process means for causing the ink to be

discharged through the ejection openings. The recovery process means causes the ink to be discharged through the ejection openings after the bubble generating means has filled the buffer portion with the at least one bubble. The recovery process means discharges the ink through the ejection openings to remove excess of the at least one bubble.

Yano, et al. is described in Applicants' specification in the Description of the Related Art and describes an ink jet printer that introduces air bubbles in an ink chamber to function as buffers. The bubbles can absorb discharge energy in the form of pressure waves directed toward the common liquid chamber. As a result, the refilling after discharge can be quickly performed.

As understood by Applicants, in Yano, et al., the heating value of a heater is controlled to fill the buffer portion with an appropriate bubble size, but controlling of the heater to achieve the desired size is difficult. In contrast, the present invention performs a recovery process after the buffer portion is filled with at least one bubble so as to remove excess of the at least one bubble. As a result, the buffer portion can be reliably filled with an appropriate amount of bubble.

The Examiner cites column 18, lines 49 and 50 of Yano, et al. for teaching that bubbles in the common liquid chamber disappear in an ejection recovery operation. However, the remainder of that paragraph describes that bubble formation control can be performed after each suction operation so that bubbles of a suitable size are formed in the common liquid chamber. That is, this section of Yano, et al. describes a process of performing a recovery process, such as idle discharge and ejection recovery, and then filling of the common chamber with a bubble.

At column 19, lines 44 to 47 of Yano, et al., it is described that air bubbles which remain in a liquid passage after an air bubble generation process are discharged by idle discharge. However, these bubbles cannot be construed as excess bubble in a buffer portion, but rather are bubbles in a liquid passage which can cause failure in ink ejection.

Accordingly, Yano, et al. fails to disclose or suggest at least filling a buffer portion with at least one bubble by driving bubble generating means and executing a recovery process of discharging ink through ejection openings after the bubble filling step, wherein in the recovery process step, excess of the at least one bubble filled in the buffer portion is removed, as is recited in independent Claim 1.

Nor does Yano, et al. disclose or suggest a recovery process means causing ink to be discharged through ejection openings after bubble generating means has filled a buffer portion with at least one bubble, with the recovery process means discharging the ink through the ejection openings to remove excess of the at least one bubble, as is recited in independent Claim 10.

Thus, independent Claims 1 and 10 are patentable over the citations of record. Reconsideration and withdrawal of the § 102 rejection are respectfully requested.

For the foregoing reasons, Applicants respectfully submit that the present invention is patentably defined by independent Claims 1 and 10. Dependent Claims 3-9 and 12-18 are also allowable, in their own right, for defining features of the present invention in addition to those recited in their respective independent claims. Individual consideration of the dependent claims is requested.

Applicants submit that the present application is in condition for allowance. Favorable reconsideration, withdrawal of the objection and rejections set forth in the above-noted Office Action, and an early Notice of Allowance are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO ABSTRACT

--The present invention allows a buffer [chamber] portion to sufficiently restrain the vibration of ink in a print head. To achieve this, the buffer portion [that effectively restrain the vibration of the ink at] is disposed close to a channel between a common chamber and an ejection opening and is filled with at least one bubble, and then excess of the at least one bubble is removed through the ejection opening.--

ABSTRACT OF THE DISCLOSURE

The present invention allows a buffer portion to sufficiently restrain the vibration of ink in a print head. To achieve this, the buffer portion is disposed close to a channel between a common chamber and an ejection opening and is filled with at least one bubble, and then excess of the at least one bubble is removed through the ejection opening.

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Amended) A method of filling a buffer [chamber] portion in a print head with at least one bubble, using a print head comprising a plurality of ejection openings through which ink is ejected, a plurality of channels that are each in communication with a corresponding one of the plurality of [channels] ejection openings, a common liquid chamber for supplying ink to the plurality of channels, a buffer [chamber] portion located at end of an [arranged] arrangement direction of said channels to restrain vibration of ink in said common liquid chamber which occurs as a result of ejection of the ink, and bubble generating means for filling the buffer [chamber] portion with at least one bubble, comprising the steps of:

filling said buffer [chamber] portion with the at least one bubble by driving said bubble generating means; and

executing a recovery process of discharging the ink through said ejection [opening] openings after said bubble filling [process] step, wherein in said recovery process step, excess of the at least one bubble filled in said buffer portion is removed.

Claim 2 is cancelled herein.

3. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

during said bubble filling step, the at least one bubble is allowed to grow up to a location of said channel adjacent to said buffer [chamber] portion by driving said bubble generating means.

4. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

the at least one bubble generated by driving said bubble generating means is obtained by precipitating a gas dissolved in the ink.

5. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

during said bubble generating step, said bubble generating means is driven to generate the at least one bubble while preventing film boiling from occurring in the ink.

6. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

said plurality of channels are each provided with an electrothermal converter as means for generating ejection energy that causes the ink to be ejected, and

during said bubble generating step, the at least one bubble is generated using said electrothermal [converter] converters together with said bubble generating means.

7. (Amended) The method [of filling buffer chamber in a print head

with bubble] according to Claim 1, wherein

said recovery process is a suction recovery process comprising [sucking] suctioning and discharging the ink through said ejection [opening] openings.

8. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

[said] the recovery process is executed before a printing operation.

9. (Amended) The method [of filling buffer chamber in a print head with bubble] according to Claim 1, wherein

before [said] the recovery process, said print head is heated [at] to a temperature used for normal printing or higher.

10. (Amended) A printing apparatus able to print an image on a printing medium, using a print head comprising a plurality of ejection openings through which ink is ejected, a plurality of channels that are each in communication with a corresponding one of the plurality of [channels] ejection openings, a common liquid chamber for supplying ink to the plurality of channels, a buffer [chamber] portion located at end of an [arranged] arrangement direction of said channels to restrain vibration of ink in said common liquid chamber which occurs as a result of ejection of the ink, and bubble generating means for filling the buffer chamber with at least one bubble, comprising:

recovery process means for causing the ink to be discharged through said

ejection [opening] openings, [and] wherein

said recovery process means [causing] causes the ink to be discharged through said ejection [opening] openings after said bubble generating means has filled said buffer [chamber] portion with at least one bubble, and

said recovery process means discharges the ink through said ejection openings to remove excess of the at least one bubble.

Claim 11 is cancelled herein.

12. (Amended) The printing apparatus according to Claim 10, wherein said bubble generating means allows the at least one bubble to grow up to a location of said channel adjacent to said buffer [chamber] portion.

13. (Amended) The printing apparatus according to Claim 10, wherein said bubble generating means generates the at least one bubble by precipitating a gas dissolved in the ink.

14. (Amended) The printing apparatus according to Claim 10, wherein said bubble generating means generates the at least one bubble while preventing film boiling from occurring in the ink.

15. (Amended) The printing apparatus according to Claim 10, wherein

said plurality of channels are each provided with an electrothermal converter as means for generating ejection energy that causes the ink to be ejected, and
said bubble generating means generates the at least one bubble together with said electrothermal converter.

16. (Amended) The printing apparatus according to Claim 10, wherein
said recovery process means [sucks] suctions and discharges the ink through
said ejection [opening] openings.

17. (Amended) The printing apparatus according to Claim 10, wherein
said recovery process means discharges the ink through said ejection
[opening] openings before a printing operation.

18. (Amended) The printing apparatus according to Claim 10, further
comprising means for heating said print head [at] to a temperature used for normal printing
or higher before said recovery process means discharges the ink through said ejection
[opening] openings.

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